TeleMed: Practical Internet Technology Applications

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1998 Health Care Internet Symposium

Fort Lauderdale, Florida

March 29-31, 1998

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Outline

- **Motivation for a Wide Area Component Architecture for Healthcare**

- **TeleMed Example**

- **Northern New Mexico Rural Telemedicine Project**

- **Lessons learned**

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Why Los Alamos?

- **Long term experience in distributed and parallel high performance computing**
  - Wide area teraflop computing for modeling and simulation
  - Distributed object technology is crucial component of meeting the goals

- **Non-proprietary prototyping**
  - Assist agencies and organizations in solving their problems
  - Help create a vision and work with industry to achieve it
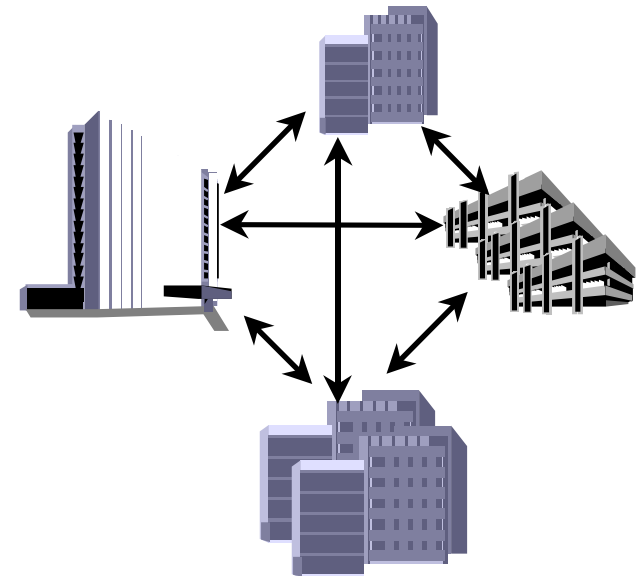
- **The Dept of Energy needs to manage its health risks**

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IDN: The Dominant Healthcare Trend
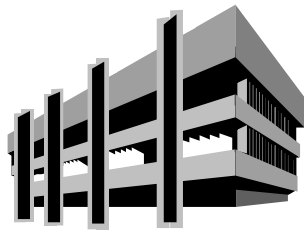
3000 US
Hospitals (1996)

600 US
IDNs (2005)

768 hospital acquisitions
and mergers in 1996 (AHA)

Managed Care is Driving the Health Care Industry to form Integrated Delivery Networks

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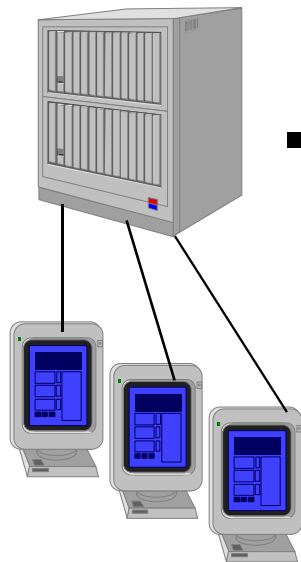
The Paper Record Dilemma

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The Computer-based Record Solution

Pathology

Lab

ADT

Cardiology

Pharm

Radiology

Charting

Computer-based Patient Record

Clinics, Diagnostic Centers, Outpatient Centers

Tertiary Care Centers

Home Care

Affiliated Practices

Nursing/Long Term Care

Pharmacy

Laboratory

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Professional Societies

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Technology Trends

1970's   **1980's**   **1990's**
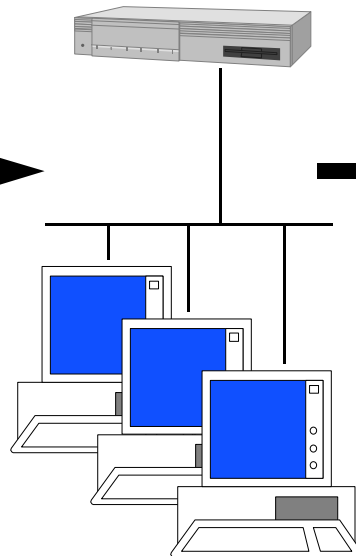
Main Frame   **Client/Server**   *Network Centric*
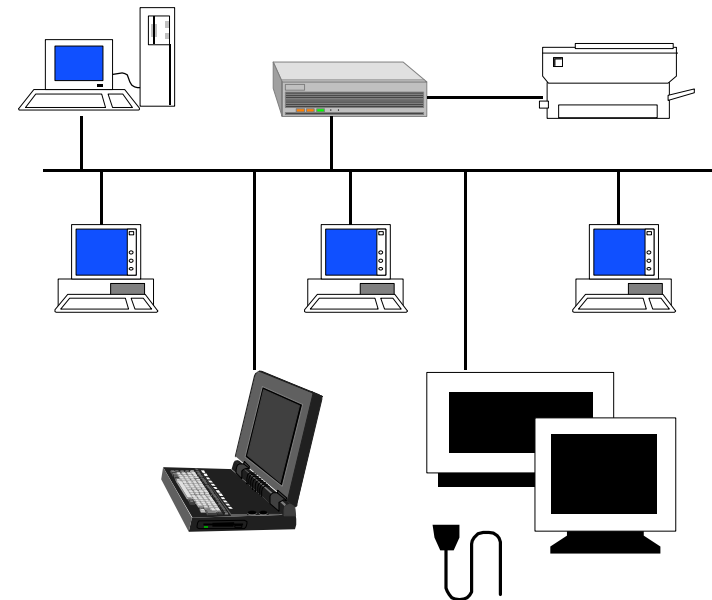   *Distributed*
                                        Computing

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IT Paradigm Shift under Managed Care
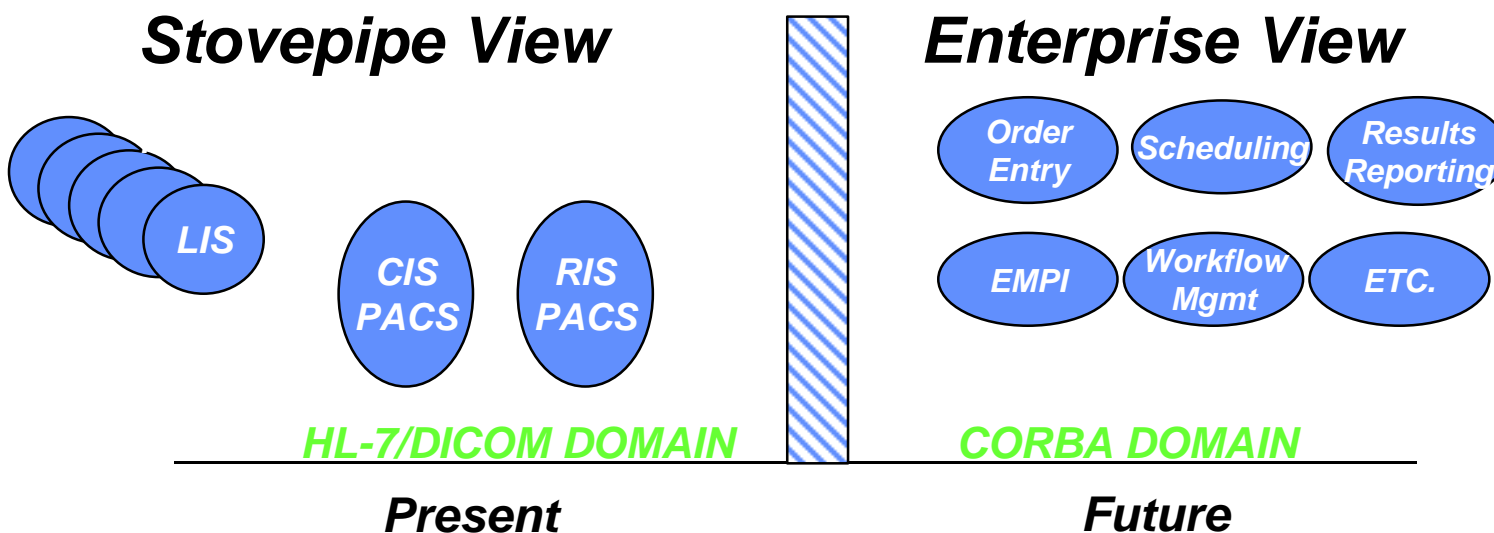
Managed Care Means Managed Information:

Enterprise-wide longitudinal CPR (40 %) | Master Patient Index (37%)

Enterprise-wide Scheduling (40%) | System-wide access (33%)

(Survey by Modern Healthcare, Feb 1997)

Stovepipe View

LIS

CIS PACS

RIS PACS

HL-7/DICOM DOMAIN

Present

Enterprise View

Order Entry

Scheduling

Results Reporting

EMPI

Workflow Mgmt

ETC.

CORBA DOMAIN

Future

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CORBA Offers an Answer
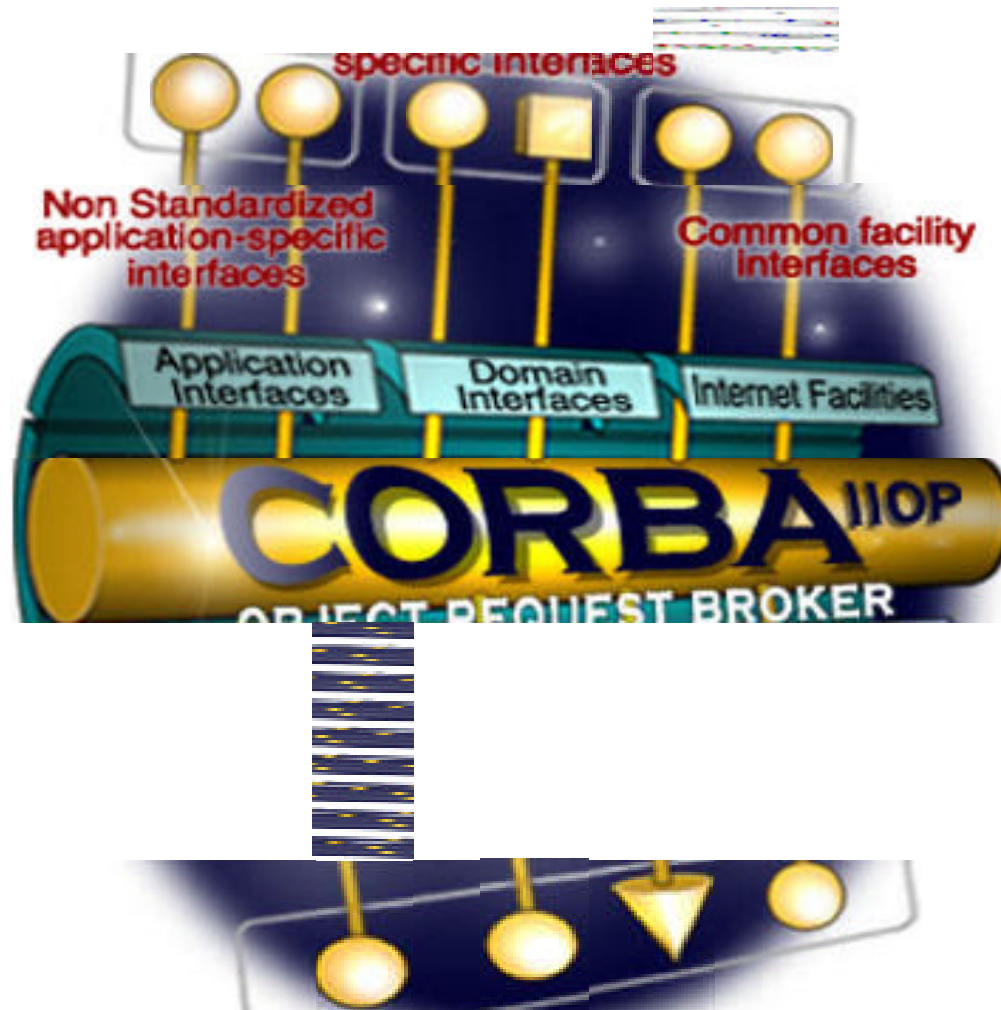
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CORBA Offers the Pieces
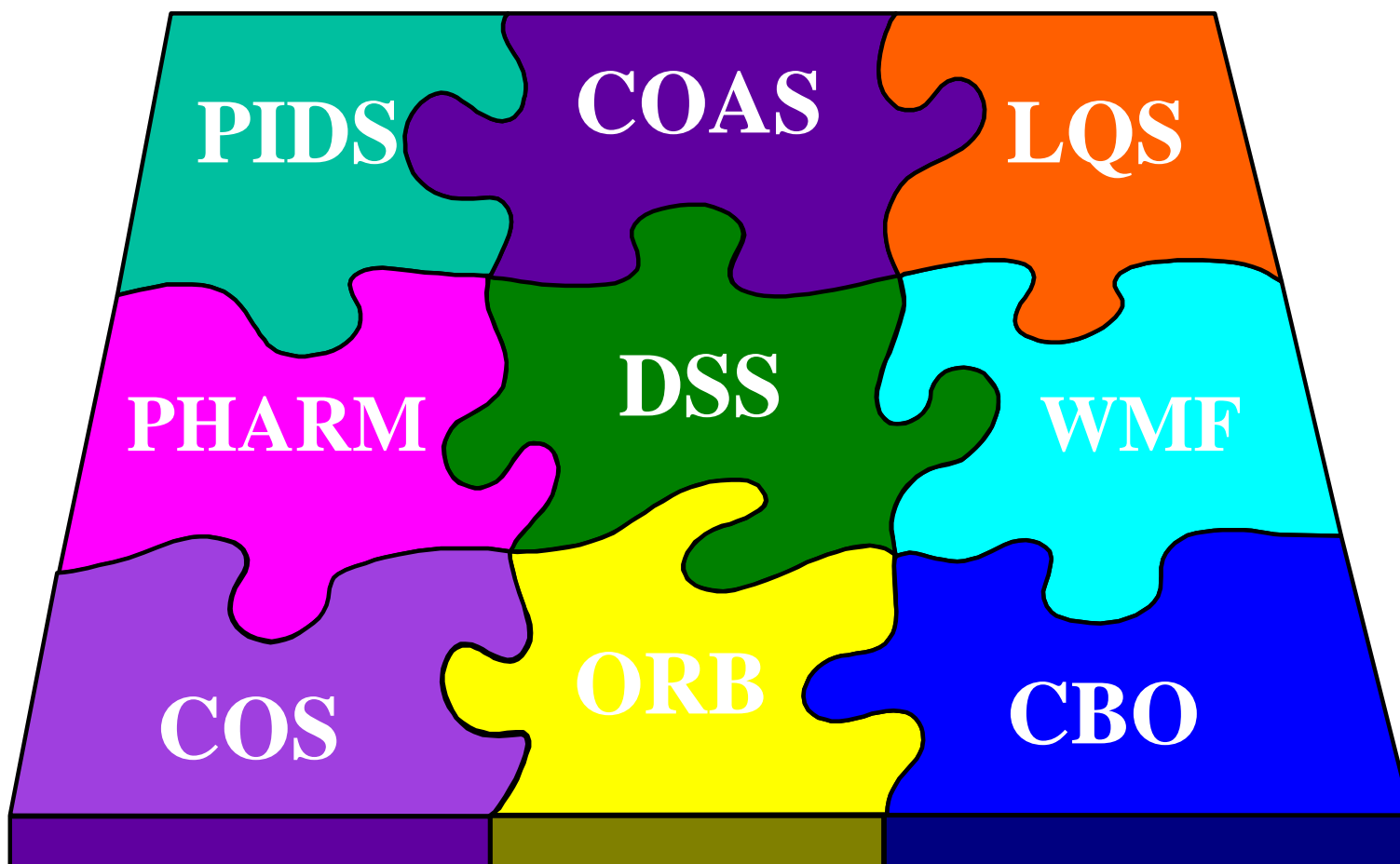
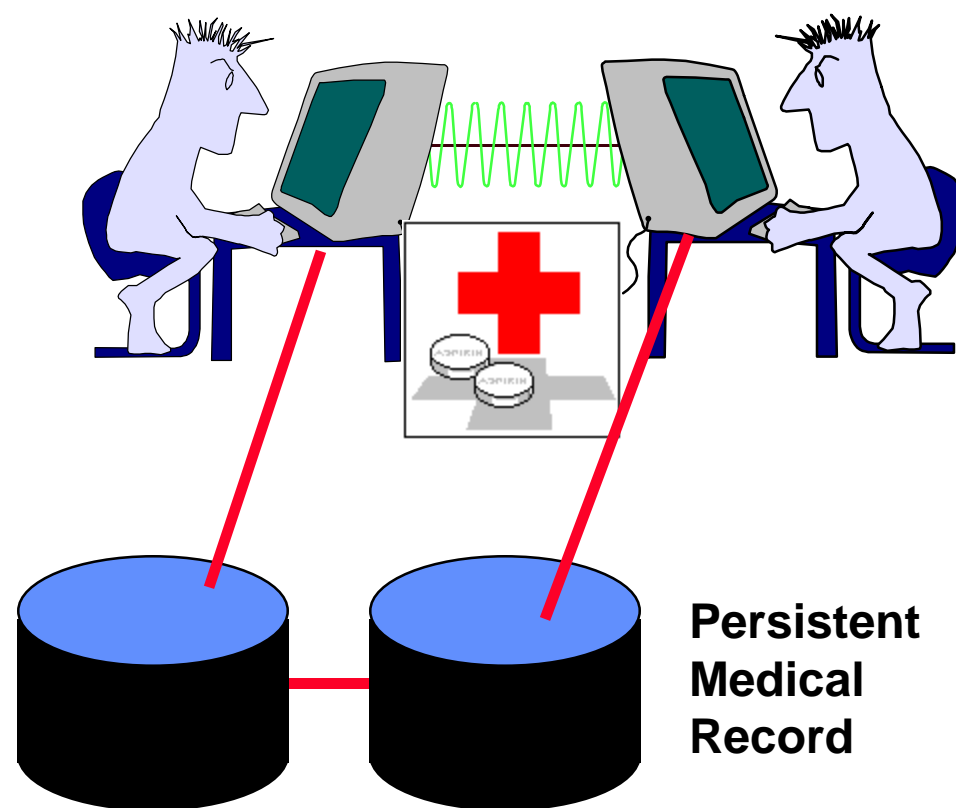*Los Alamos*
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The Global Context

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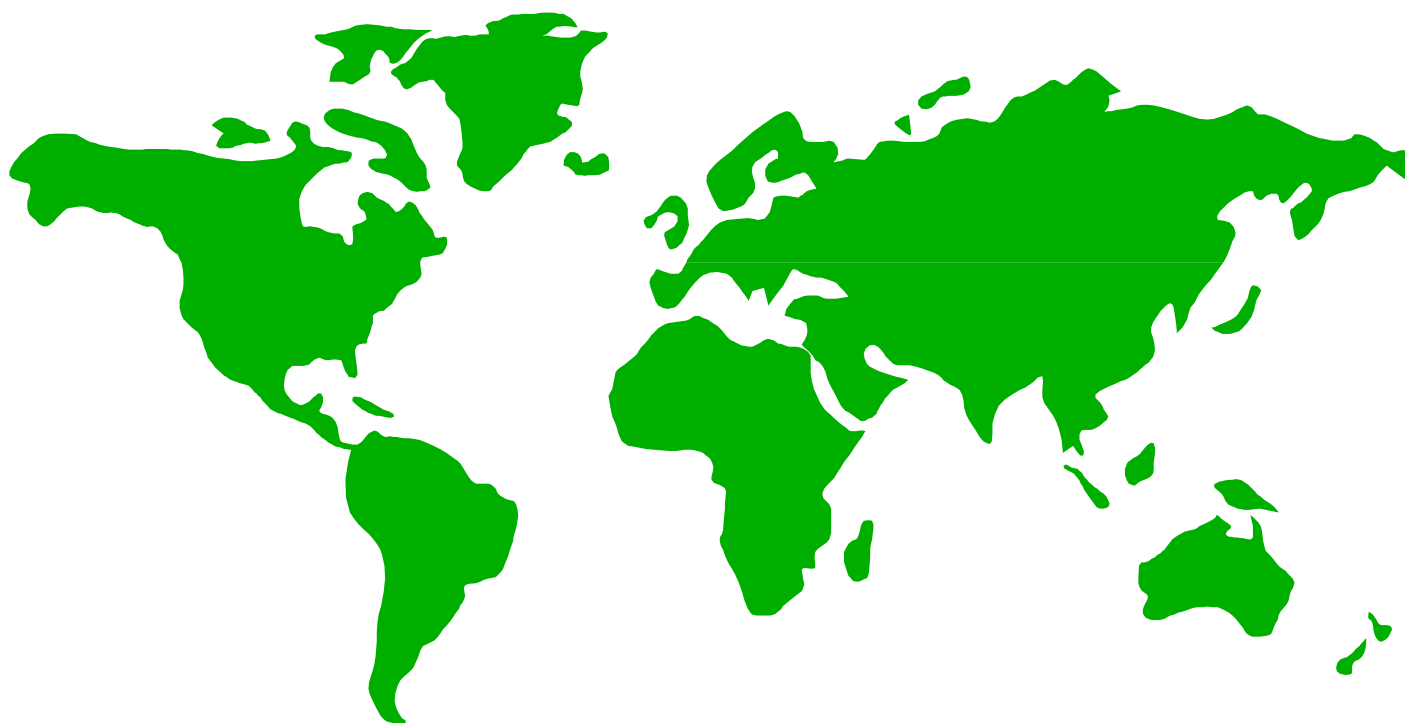
Patient Identification Service

- Standard has been adopted (2/12/98) for managing patient identification across enterprise and beyond.

- Was demonstrated with multiple vendors and platforms at HIMSS last month.

- Provides for multiple communicating domains, correlation management including merging and un-merging patient identifiers

- Extensible traits with first implementation on HL7 and vCard (including sound and photos)

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Distributed Healthcare

- **Synchronous and Asynchronous Communications**
- **Ease of Use**
- **Data Integrity**
- **Ensure privacy and confidentiality**
- **Right information for task**
- **Data mining**
- **Virtual Patient Record**

Persistent Medical Record

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TeleMed is Using CORBA to Integrate Across Healthcare Enterprises

- **Standards-based (CORBA/Interoperable, Java, JavaDataBaseConnection,ObjectDataMgtGrp)**

- **Distributed multimedia database**

- **Scalable/Extensible**

- **Web-accessible**

- **CORBA-based security with private/public key and point-to-point encryption**

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TeleMed Principles

- Move data only as necessary
- Manage complex high-volume data in understandable manner
- Same system for real-time consultations as for asynchronous consultations
- Leverage internet standards
- Design for ease of use in clinical setting
- Plug-and-play design
- User Interface must be intuitive

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Java + CORBA

- Enables robust, scalable electronic medical record

- Multi-tiered architecture support

- Easy to distribute client software

- Flexible interface

- Collaborative tools and support for distributed event management

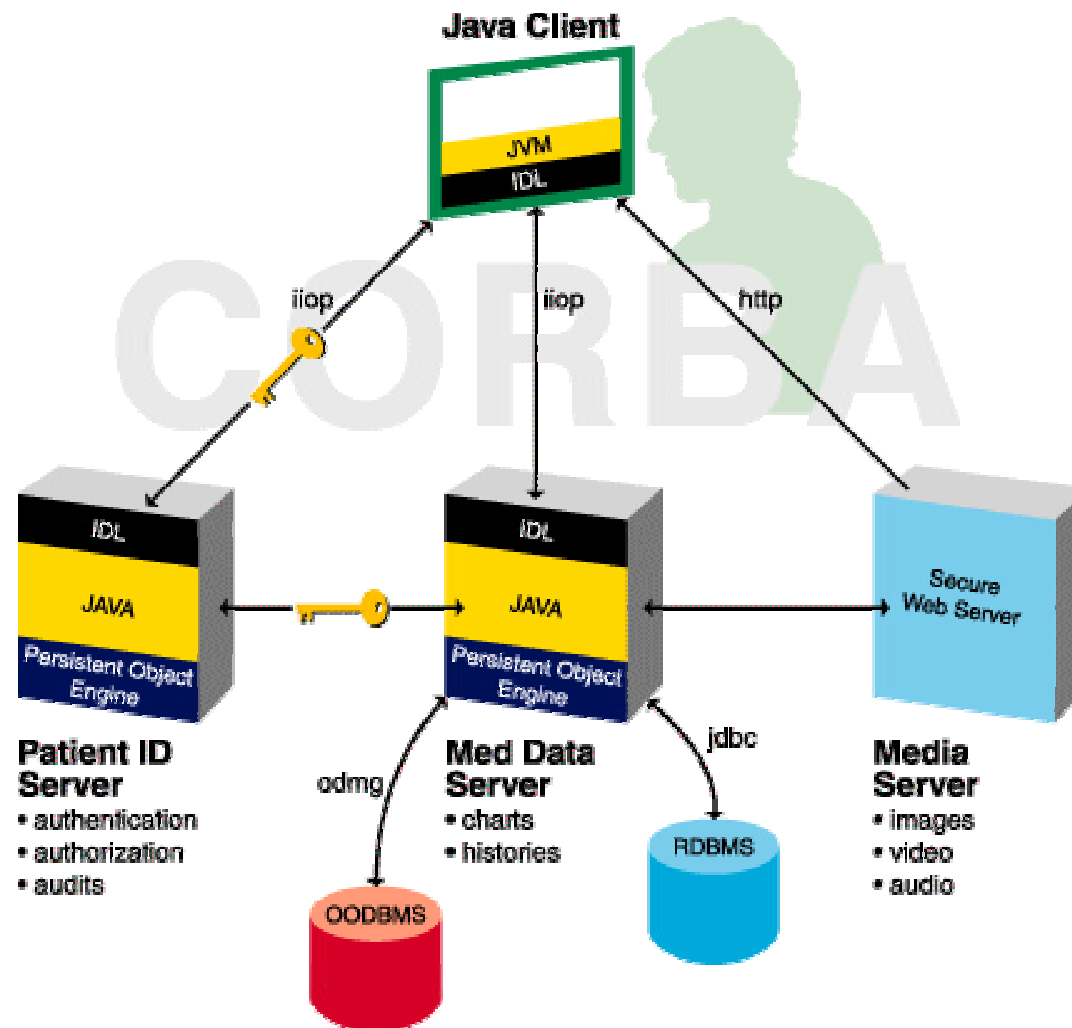- Java Beans Interoperable Components

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Clinical Use of TeleMed

- **Used at NJC for chronic mycobacterial disease**
  - Review data for new patients referred to NJC
  - Prepare for follow up visits
  - Advise physicians at remote sites

- **Imaging not fully integrated**

- **System designed around needs of physician**

- **Integrates patient history, Lab studies, drug treatments, various reports, image studies, and text/audio annotations in a longitudinal record**

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TeleMed Architecture

Java Client

JVM

IDL

iiop   iiop   http

IDL   IDL   Secure Web Server

JAVA   JAVA

Persistent Object Engine   Persistent Object Engine

Patient ID Server
• authentication
• authorization
• audits

odmg   **Med Data Server**
              • charts
              • histories

jdbc

OODBMS   RDBMS

Media Server
• images
• video
• audio

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TeleMed Imaging

- **GE/DICOM images converted to Internet standard: Portable Network Graphics for rapid viewing**

- **Java viewer handles 16 bit images**

- **Database stores metadata**

- **Images stored in multimedia datastore using http for easy access.**

- **System designed for low bandwidth**

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TeleMed Security Model

Provide capability for authentication and authorization to view distributed data

- Secure data at object level, allow policy to drive security deployment

- Use public/private key with point-to-point encryption

- Client security managed with inexpensive but robust hardware: iButton

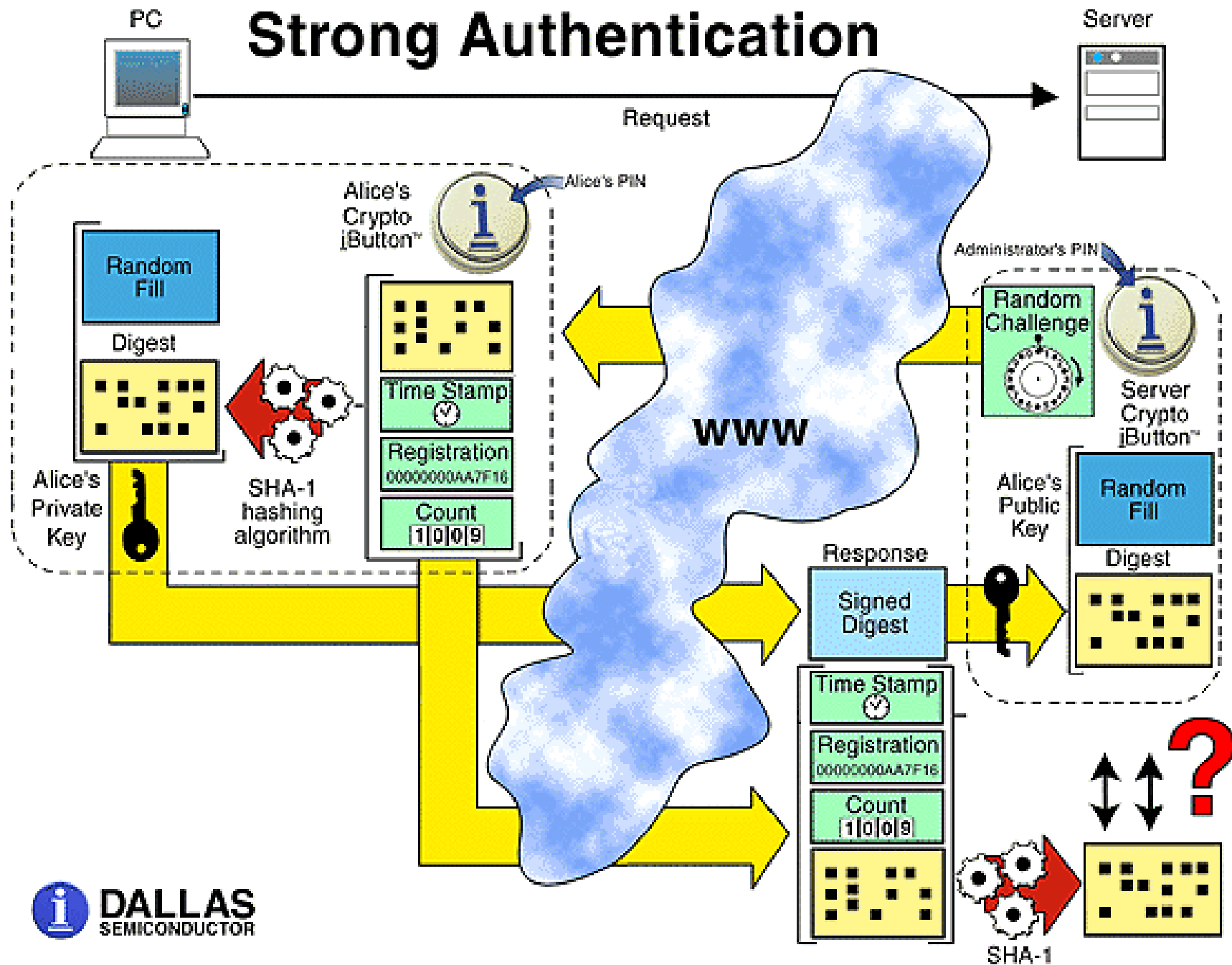*Los Alamos TeleMed*

Robust client security

- Windows 95 insecure!
- Inadequate for managing private keys
- Use Cryptographically-secure iButton to manage private key
- Provide user-friendly, high level security at low cost
- Integrate with CORBAsecurity

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Strong Authentication

Significant Results from TeleMed

- **Powerful intuitive interface**
    - **Graphical Patient Record**
- **Ability to reduce treatment costs and improve patient care**
- **Integration of multimedia data from a variety of sources is useful in many applications**
- **Data mining techniques can be used by non-technical users**
- **Truly practical use of distributed high performance computing.**
- **Java/CORBA integration practical**

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Northern NM Rural Telemedicine Project

- **NTIA (TIIAP Grant to Northern NM Community College, Espanola ($500K over 2 years) + Match**
- **16 Rural Clinics from**
  - **Health Care Centers of Northern New Mexico**
  - **Las Clinicas del Norte**
- **Regional Hospitals**
  - **Espanola Hospital and Los Alamos Medical Center**
- **Commercial Partners:**
  - **Intel, FileNet, Hublink, NM Dept of Health, Dallas Semiconductor, Citizen1, Information Assets, GSTI, …**
- **Comprehensive evaluation before and after deployment**

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The Need

- **Rural clinics in Northern New Mexico**
  - sparsely populated
  - large distances separating clinics and hospitals
  - few resources for information management

- **Confused medical records**
  - same name, different patients
  - same patient, different names
  - same Social Security number, different patients

- **Repeated treatments for same condition**
  - lack of sharing between clinics

- **Referral slips do not arrive in time**

- **Continuing education for health care providers**

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The Project

- **Create Electronic Medical Records**
  - immunization records
  - prescriptions
  - allergies
  - patient encounters

- **Share Records over the Internet with**
  - confidentiality
  - security
  - surety

- **Test and Validate first prototypes of a Distributed Master Patient Index**
  - Based on CORBAmed PIDS Standard

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The Project (cont.)

Evaluation and Validation

- **Comparison (before and after implementation)**
  - number of patients with immunization records
  - number of patients with allergy records
  - instances of multiple patient records
  - number of lost records

- **Subjective evaluations**
  - time to enter records
  - communication with other clinics
  - access to medical information

- **Job-task-analysis of affected jobs**

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Job Task Analysis

- **Medical Record Keepers**
  - creating new patient records and processing patients

- **Providers**
  - documenting patient interactions
  - reviewing patient progress
  - view medical record as information source for analytical and decision making activities.

- **Design of TeleMed needs to meet both needs.**

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Experiences

- **Internet training needed for medical records and health care providers**

- **Bringing various partners to the table breaks down barriers**

- **Enthusiasm continues to be high**

- **Network is up at about 8 sites**

- **Feedback being obtained for the medical record and data input mechanisms using TeleMed itself!**

- **Security is near deployment**

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TeleMed Information

- **For more info:**
  `http://www.acl.lanl.gov/TeleMed`

- **"*An International Collaboratory based on Virtual Patient Records*" August 1997 Communications of the ACM**

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